

Chapter 1 Continued

Using the Metric System

Mathematical Operations

Significant Digits

- What seems to be wrong with this number?
\$ 67.34789721

We typically don't worry about fractions of a penny.

Where do you see fractions of a penny in sale prices?

Mathematical Operations

Significant Digits

- What's the smallest measurement one can make with a meter stick?
- It can measure to the nearest millimeter, which is 0.001 meters.
- As you can see there are limitations of certainty in scientific measurements.
- In other words, it would be wrong to list a calculation carried out to four decimal places that uses data obtained from a meter stick.
- **THAT'S WHY WE HAVE SIGNIFICANT DIGIT RULES!**

Significant Digit Rules

<u>Example</u>	<u># of Sig. Digs</u>
1.654	4
0.00437	3
64,000	2
1.200	4
0.10000738	8

Significant Digit Operations

- Rule 1: (Mult/Div) Find the number in the operation with the least amount of significant digits. Give your answer in that amount of significant digits.
- Example: $25.4 \times 3.4 =$

Significant Digit Operations Continued

- Rule 2: Add/Subtract: Round the result of the calculation to the same number of decimal places as the number in the calculation given to the least decimal places.
- Example: $11.24 + 13.1 =$

Multiple Operations

- Example: $34.7 + 1.24 \times 8.635 = ?$

The Metric System

- In science we use the metric system to make measurements and calculations
- The metric system is really called the “SI” system for “System International”
- It’s used almost everywhere in the world except in the U.S., Liberia, and Burma



Benefits of the metric system

- English units are hard to convert.
 - Ex) How many feet are in a mile?
 - 5,280
 - -Ex) How many inches are in 3 feet?
 - 36
 - Ex) How many inches are in half a mile?
 - 31,680
- With the metric system you don't have to think too hard about converting. Everything is based on powers of 10

How to work with the metric system

- The metric system has a series of prefixes for really big and really small numbers
- | | | | |
|------------------------------|----------------------|-----------------------------|-------------------------|
| Giga | 1,000,000,000 | 10^9 | G |
| Mega | 1,000,000 | 10^6 | M |
| Kilo | 1,000 | 10^3 | k |
| no prefix (base unit) | 1.0 | 10^0 | |
| Centi | 0.01 | 10^{-2} | c |
| Milli | 0.001 | 10^{-3} | m |
| Micro | 0.000001 | 10^{-6} | μ |
| Nano | 0.000000001 | 10^{-9} | n |

What things do we measure?

- The three base quantities in physics are mass, length, time

	Mass	Length	Time
SI	Kilogram	Meter	Second
English	Slug	Foot	Second

How to work with the metric system

- First, be familiar with scientific notation
 - Ex) An easier way to say 3,600 is...
 3.6×10^3
 - Ex) An easier way to say 5,460,000 is...
 5.46×10^6
 - Ex) An easier way to say 0.0071 is...
 7.1×10^{-3}

More scientific notation

- Write 4.5×10^5 as a whole number
 - 450,000
- Write 6.77×10^{-6} as a decimal
 - 0.00000677

Making scientific notation work with the metric sytem

- Ex) What's an easier way to say 6,400,000 meters?
 1. Convert to sci. not. 6.4×10^6 meters
 2. Look at the chart and replace 10^6 with the prefix "Mega"
 3. Write as 6.4 Mega meters which can be written as 6.4 Mm

Practice



Answer

- Write these measurements with the appropriate metric prefix

- 9,200 meters

- 5,700,000 grams

- 0.0034 seconds

- 0.00000122 seconds

- 9.2 kilometers (9.2 km)

- 5.7 megagrams (5.7 Mg)

- 3.4 milliseconds (3.4 ms)

- 1.22 microseconds (1.22 μ s)

More Practice

- Go the other way. Write these measurements with the base units

- 7.1 kilometers
- 2.3 micrograms
- 56 milliseconds
- 45 megagrams

Answer

- 7,100 meters
- 0.0000023 grams
- 0.056 seconds
- 45,000,000 grams

Factor-Label Method

Metric/English

- Ex) How many feet are in 22.5 m?
- Ex) How many kilometers are in 330 miles?
- Ex) How many seconds are in a week?

Factor-Label Method

Metric/Metric

- Ex) How many kilometers are in 61,400 m?
- Ex) How many milligrams are in 8.2×10^{-4} kilograms?
- Ex) How many microseconds are in 12.5 milliseconds?

Factor-Label Method

Rates and Volumes

- Ex) How many miles per hour are in 17.0 m/s?
- Ex) How many square feet are in 0.83 m²?